3-Step Performance Assessment Of A Pedestrian Crossing Time Prediction Model

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Introduction

- 2025: + 58 % of world‘s urban population
- In Europe: 5180 ped deaths/year

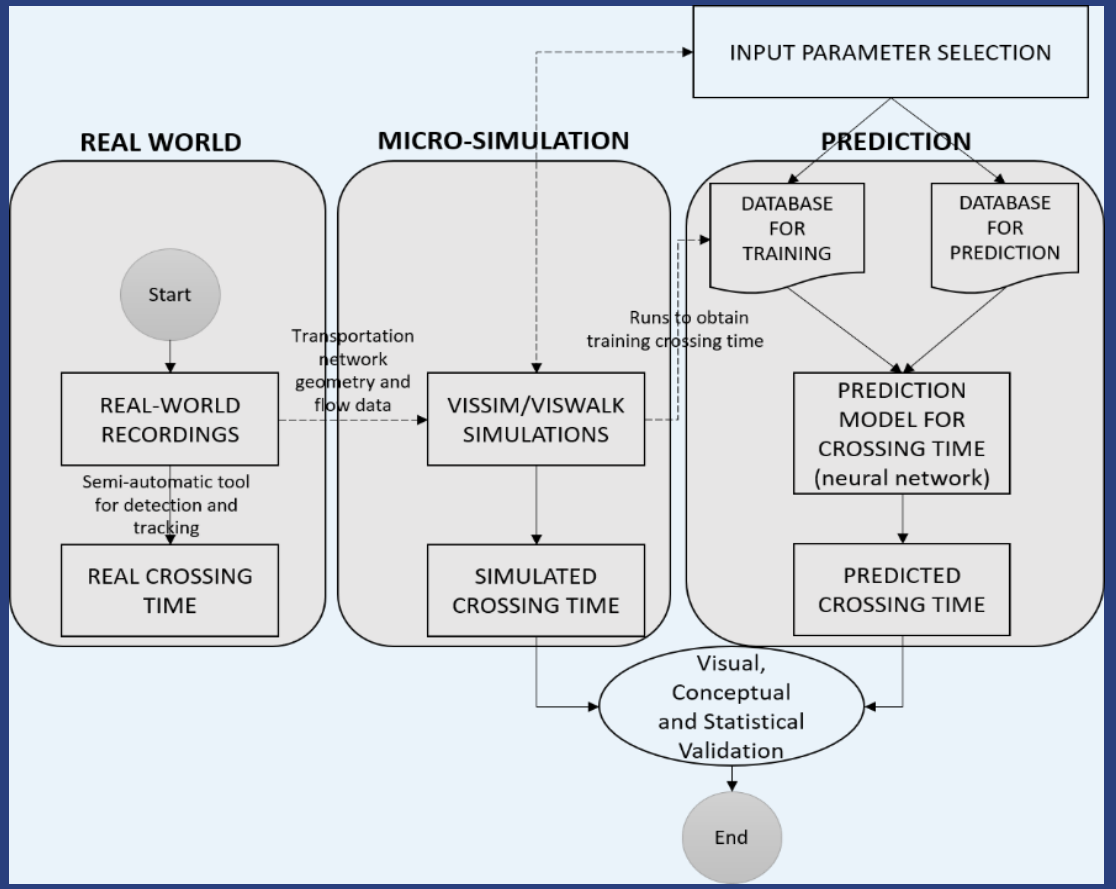
How to deal with pedestrian behavior and safety?

MICROSIMULATION IS A WAY

Addressed problem

FOCUS: pedestrian crossing action at roundabout crosswalk

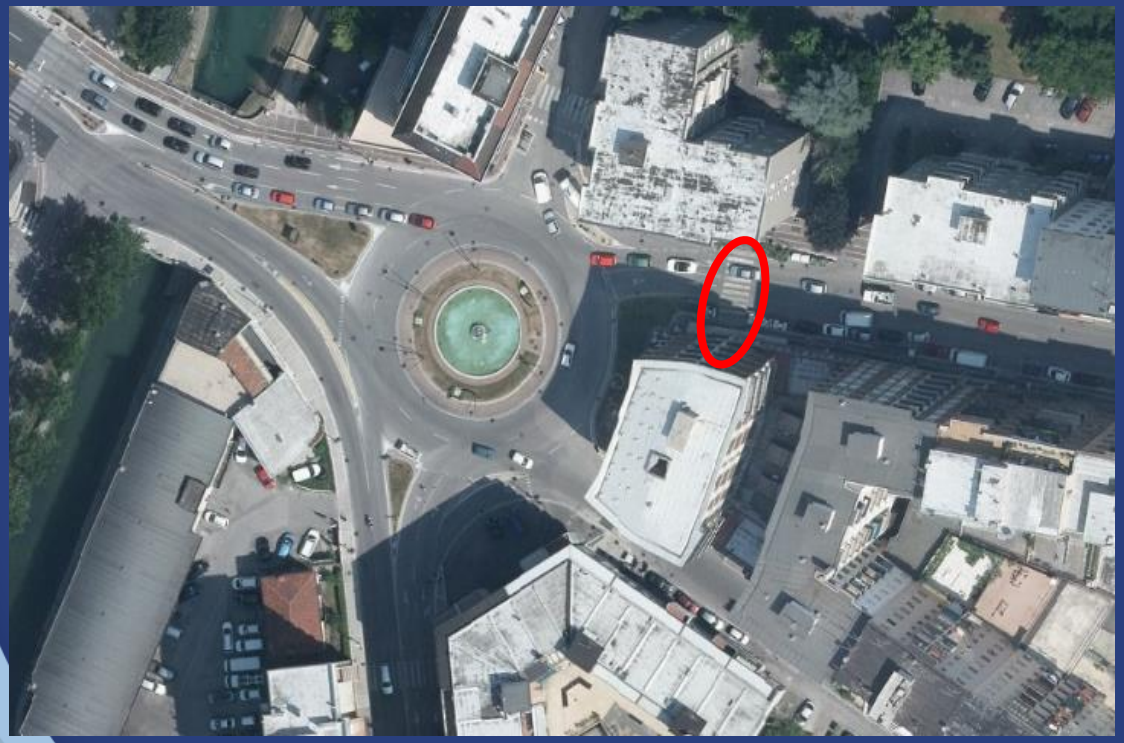
Is it possible to reproduce pedestrian crossing action (as modelled in Vissim/Viswalk) by mean of a chosen predictive model?



First steps for the development of the calibration methodology

Case study location

Monfalcone, Italy



Urban roundabout set in Monfalcone (GO) Italy

Pedestrian Speed Distribution	Lower Bound	3.12	km/h
	Upper Bound	8.71	km/h
pedestrian flows (from-to)	1–3	43	peds/hr
	2–4	20	peds/hr
	3–5	3	peds/hr
	4–1	46	peds/hr
	5–2	20	peds/hr
vehicular flows (on link)	2	325	veh/hr
	1	325	veh/hr
	3	650	veh/hr
	4	165	veh/hr
	5	165	veh/hr
vehicular speed distribution	lower bound	15.5	km/h
	upper bound	50.67	km/h

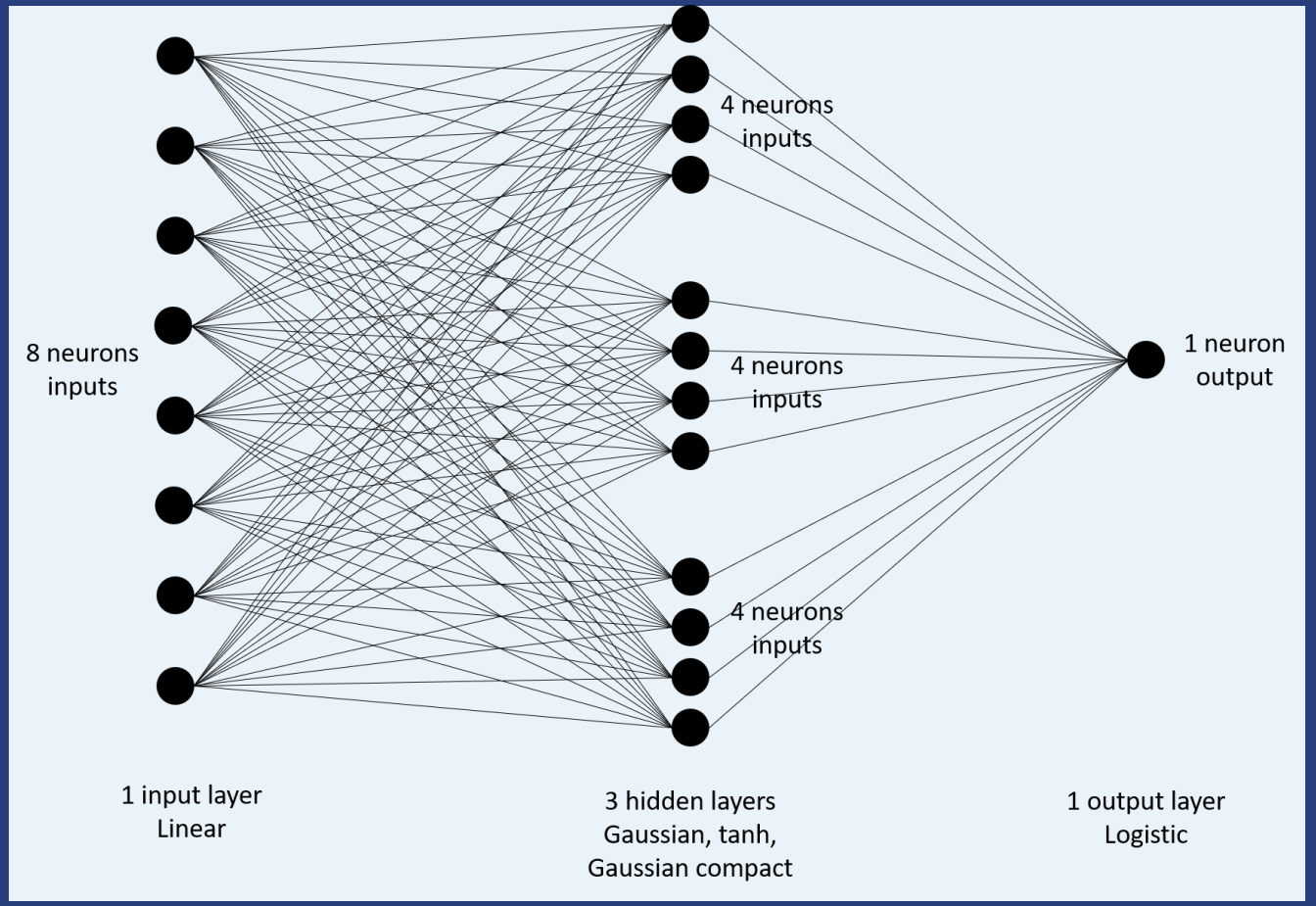
Pedestrian and vehicular flows measured and used in the model

Parameter selection and database creation

Input	Name	Description	Min	Max
I1	Tau	Relaxation time	0.05	2
I2	Lambda	Amount of anisotropy	0	0.4
I3	Asoc_iso	Parameter governing pedestrian forces	3	7
I4	Bsoc_iso	Parameter governing pedestrian forces	0.1	10
I5	Side_pref	Side preference	-1	1
I6	Avg standstill distance [m]	Average standstill distance	1	3
I7	Additive part of safety distance [m]	Additive part of safety distance	1	5
I8	Multiplicative part of safety distance [m]	Multiplicative part of safety distance	1	6

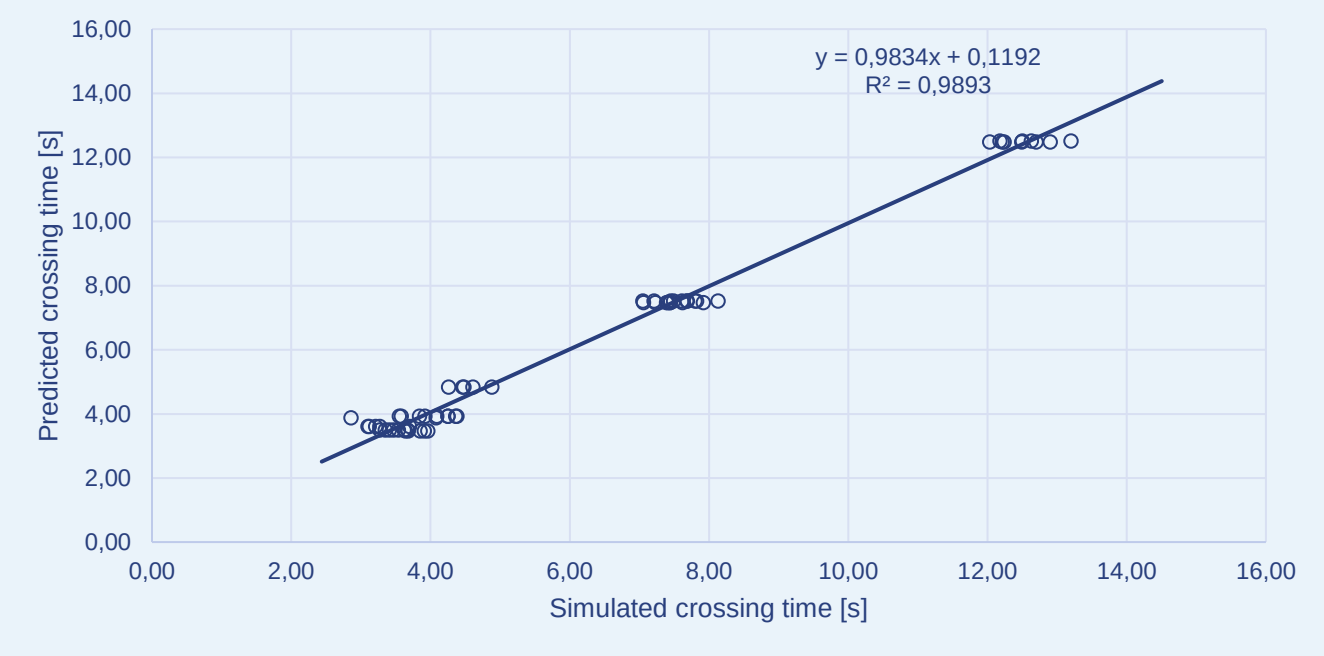
Pedestrian and vehicular microsimulation parameters selected in the current study

The prediction model



Structure of the chosen ward network

Validation results: visual validation



Comparison between the simulated outputs and the accepted values, predicted by the ward network

Results of Anderson-Darling test

	Simulated (Vissim)	Predicted (Neural Network)
AD	6.355	10.424
P-Value	<0.005	<0.005

Statistics of the simulated and predicted crossing times [s]

	Simulated (Vissim)	Predicted (Ward Network)
Mean	6.41	6.32
Standard error	0.35	0.34
Median	4.57	4.38
Mode	3.27	3.50
Standard deviation	3.50	3.43
Variance	12.26	11.76
Kurtosis	-0.44	-0.63
Asimmetry	0.95	0.96
range	12.06	9.04
Min	2.44	3.4
Max	14.5	12.51
Confidence level	0.69	0.68

Validation results: conceptual validation

HCM (2016) - signalized:

$$t_c = t_s + \frac{L}{v_p} + (a * \frac{N_{ped}}{W}) \qquad \text{(Eq. 7)}$$

HCM (2016) - unsignalized:

$$t_c = \frac{L}{v_p} + t_s \qquad \text{(Eq. 8)}$$

Ranges of crossing time found in literature

Authors	Crossing typology	Crossing time range [s]
Present findings	Unsignalized, on roundabout entry leg	6.318 (predicted - NN); 6.407 (simulated - Vissim)
(HCM, 2016)	Unsignalized crossings (time gap – calculated for the given geometry)	11.6
(National Joint Committee on Uniform Traffic Control Devices (U.S.). (1971))	Signalized crossings	11.26
(Jain, 2014)	Uncontrolled crossing – one step	5.0-9.0
(Jain, 2014)	Uncontrolled crossing – two steps	3.0-12.0
(Virkler, 1984)	Signalized crossing	9.0-15.6
(Thompson, 2013)	Various intersections	10.4 (average value)
(Malinovskiy, 2008)	Signalized intersections	4.5-9.2

Validation results: operational validation

Results of Bonett's and Levene's tests

Test	Confidence interval for StDev ratio	Confidence interval for variance ratio	P-Value
Bonett	(0.845; 1.228)	(0.715; 1.509)	0.822
Levene	(0.760; 1.402)	(0.578; 1.966)	0.846

Conclusions

Visual validation: 97 % on training dataset; 94 % on validation dataset.

Conceptual validation: agreement of simulated and predicted data with real-world measurements and ranges of crossing time found in literature.

Operational validation: non-significant statistical difference between simulated and predicted crossing times.

Promising results for the application of the prediction model to the calibration process.

Thank you for your attention!

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